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SEGMENTAL INCHING OF MEDIAN NERVE: ESTABLISHING ABNORMAL CUT-OFF VALUE TO DIAGNOSE CARPEL TUNNEL SYNDROME

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Abstract

This study was aimed to obtain preliminary normative data of median sensory nerve inching in our setup and population for electrodiagnosis of carpal tunnel syndrome (CTS). Orthodromic inching of the median nerve was performed by stimulating the second digit of 42 wrists (14 males and 7 females. The mean ages of males and females were 28.1±1.68 yrs and 26.4±3.6 yrs respectively. The sensory nerve action potential (SNAP) latency and amplitude were measured in segments 3 cm proximal to the distal wrist crease and 4 cm distal to it. The mean SNAP latency and amplitude in males was 1.93±0.31ms and 30.53±10.65μV respectively. In females, the mean SNAP latency was 1.75±0.2ms and amplitude, 32.8±10.41 μV. The mean conduction delay per centimeter (CD/cm) was 0.19ms in both genders. The maximal CD/cm was 0.3ms in males and 0.35ms in females in the segment 1cm distal to the distal wrist crease. The abnormal cut-off value, calculated as the maximal CD/cm + 2SD was 0.63/0.57ms in males and females respectively. Since, these nerve conduction study parameters vary with the laboratory conditions, demographic profile and anthropometric measurements of the population; this median sensory nerve inching study provides preliminary normative data that will aid in electrodiagnosis of CTS.

Keywords: carpal tunnel, conduction delay, inching, sensory

Carpel tunnel syndrome (CTS) is the commonest median nerve entrapment neuropathy. It results from compression of the median nerve within the carpal tunnel, of diameter 2-2.5 cm, bounded by carpel bones and transverse ligaments attached to scaphoid, trapezoid and hamate. CTS occur commonly between 30 and 60 years of age and are five times more common in women. Risk factors for CTS are older age, overweight and physically inactive people. Clinical features include pain and parasthesias in the hand, which aggravates at night[2]. Passive flexion or hyperextension of the affected hand at the wrist for more than one minute may worsen the symptoms[3].

Simpson's original contribution on carpal tunnel syndrome, demonstrating focal slowing at the wrist, paved the way for clinical conduction studies of this entity[4]. Early work yielded a higher sensitivity of sensory nerve conduction testing than studies of the motor axons[5-8]. The sensory and motor axons show a comparable degree of abnormalities, often encountering selective involvement of motor fibers, with normal sensory conductions or vice versa[9].

Electrophysiological test (NCS and/or EMG) are very sensitive that they can not only confirm the clinical diagnosis[13] in most patients but also detect an incidental finding in some asymptomatic subjects[10].

NCS assess peripheral sensory functions by recording the evoked responses i.e. sensory nerve action potential (SNAP) to stimulation of peripheral nerves[12]. Diagnosis reached at the end of NCS is usually peripheral neuropathy, carpal tunnel syndrome etc [12]. NCS parameters are known to vary with demographic profile, anthropometric measurements of the population studied and laboratory conditions of the test[11-13]. Till date we report the suspected cases of CTS by the available reference data on western population, which may not be appropriate for our setup. Therefore, our study was aimed to obtain a preliminary NCS normative/reference data for electrodiagnostic evaluation of CTS in our setup.

MATERIALS AND METHODS

This cross sectional comparative study was done in 42 wrists of healthy adults (m: 14; f: 7) at Clinical Neurophysiology Lab of BPKIHS. Informed written consent was taken from the subjects before screening them for any history of drugs/alcohol

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intake or medical illness likely to affect the NCS parameters. This was done based on the clinical history and physical examination including detailed neurological assessment. Pre-recording procedure included maintenance of laboratory temperature at the thermo neutral zone i.e. 26±2 degree Celsius. Further, subjects were made comfortable with the laboratory set up and conditions. Then, anthropometric and NCS variables were recorded[1, 2].

Table 1: Standards of stimulation and recording sites of sensory nerves

Sensory nerves	Stimulation site	Recording site	Method of stimulation
Median	Index finger	Middle of the wrist	Orthodromic
Ulnar	Little finger	Medial wrist	Orthodromic

Anthropometric variables: age, sex, height, weight, body mass index (BMI) and body surface area (BSA).

Sensory NCS variables: Ring electrodes were used for orthodromic stimulation of median and ulnar nerves (see table 1). Stimulating or recording electrodes were placed on a purely sensory portion of the nerve. Gain at 10-20 mV per division and electrical pulse duration of 100 or 200 micro seconds was used. Current was slowly increased from a base line of 0 mA, by 3-5 mA at a time until the supramaximal stimulation of nerve was ensured. For each stimulation site, sensory nerve action potential (SNAP) latency, duration, amplitude, and conduction velocity of median and ulnar nerves were recorded under standard laboratory conditions using Nihon Kohden machine (NM-420S; H36, Japan).

Sensory inching across the wrist: Bilateral median sensory nerves were stimulated over the second digit with the ring electrodes (Orthodromic stimulation). SNAP latencies and amplitudes were obtained at successive 1-cm increments from 3 cm proximal to the distal wrist crease to 4 cm distal to it. The data obtained were entered in the Microsoft Excel Work Sheet and statistically analyzed based on distribution of observations. Statistical significance was considered at P<0.05. The Ethical Clearance of the study was granted by the Institute Ethical Review Board (IERB) of BPKIHS.

RESULTS

The mean ages of males and females were 28.1±1.68 years and 26.4±3.6 years respectively. The mean conduction delay per centimeter (CD/cm) in median sensory nerve inching was 0.19ms in both genders. The maximal CD/cm was 0.3ms in males and 0.35ms in females in the segment 1cm distal to the distal wrist crease. The abnormal cut-off value, calculated as the maximal CD/cm + 2SD was 0.63/0.57ms in males and females respectively.

The mean conduction delay per centimeter (CD/cm) in median motor nerve inching was 0.29ms and 0.25ms in males and females respectively. The maximal CD/cm was 0.53ms in males and 0.70ms in females in the segment 1cm to 2cm distal to the distal wrist crease. The abnormal cut-off value, calculated as the maximal CD/cm + 2SD was 1.43/1.22ms in males and females respectively.

DISCUSSION

In our study, motor and sensory latencies of bilateral median and ulnar nerves were longer in males than the females. Our findings were similar to earlier studies[15-22]. Probably, the reason behind this finding

Table 2: Gender differences in Sensory Nerve conduction variables

Gender	Nerves	Conduction velocity(m/s)	Amplitude (µV)	Latency (ms)
Male	Median	60.62±8.99	30.53±10.65	1.94±0.32
Female		59.99±7.13	32.78±10.41	1.75±0.2
Male	Ulnar	66.7±10.6	17.24±4.09	1.63±0.24
Female		64.4±11.1	18.48±7.26	1.51±0.21

Table 3: Conduction Delay (CD) Value of 1-cm Segment Study of median sensory nerves

1-cm Segment	Female	Male
Seg I	0.14±0.09	0.16±0.07
Seg II	0.14±0.08	0.14±0.08
Seg III	0.17±0.10	0.18±0.09
Seg IV	0.35±0.11	0.30±0.16
Seg V	0.26±0.11	0.25±0.14
Seg VI	0.11±0.11	0.18±0.14
Seg VII	0.11±0.05	0.13±0.14
Mean ± SD	0.18±0.09	0.19±0.12

may be the greater height and limb length of the male volunteers. Huang in his study found that female subjects had shorter latency in the upper limb[23]. The CMAP amplitudes of the median and ulnar motor nerves were also higher in males as compared to the females[22]. This may be due to the larger muscle mass and motor unit size in males. However, the SNAP amplitudes were interestingly higher in females than the males. The probable reason in amplitude differences may be partly related to volume conductor characteristic of body mass. According to Kimura, gender related amplitude differences persist despite of the adjustment of height[17]. Hennessey et al and Fujimaki et al findings were similar to ours and they also confirmed that women had greater SNAP amplitude than men in the upper limb nerves (median, ulnar, and radial) [24, 25]. Contrary to our result, Shehab et al and Stetson et al in their study in the upper limb nerves (median, ulnar) confirmed that gender did not have any statistically significant effect on SNAP amplitude[19, 26].

Our study obtained the mean conduction delay per centimeter (CD/cm) of 0.19 ms (range, 0.13-0.30 ms in males and range, 0.181-0.35 ms in females) in median sensory nerve inching of both genders (controls). Whereas, the mean conduction delay per centimeter (CD/cm) in median motor nerve inching was 0.29ms (range, 0.18-0.53 ms) and 0.25ms (range, 0.13-0.70 ms) in males and females respectively. Our findings were different than that of Yoon-Kyoo Kang et. al. They confirmed a mean conduction delay per centimeter (CD/cm) of 0.21ms (range, 0.17-0.27 ms) in controls[27].

The maximal CD/cm in sensory nerve inching was of 0.3ms in males and 0.35ms in females at the segment IV (i.e. 1cm distal to the distal wrist crease). In median motor inching, the maximal CD/cm was 0.53ms in males and 0.70ms in females at the segment V (i.e. 1cm to 2cm distal to the distal wrist crease). Our findings were different than other author, where they found the maximal CD/cm of 0.27ms at 3 to 4 cm distal to the distal wrist crease[27]. The abnormal cut-off value in motor nerves, calculated as the maximal CD/cm + 2SD was 0.63/0.57ms in males and females respectively. All the CD/cm in each segment of controls was less than this value, with the largest latency difference being 0.26ms. Whereas, the abnormal cut-off value, calculated as the maximal CD/cm + 2SD was 1.43/1.22ms in males and females respectively.

Since, these nerve conduction study parameters vary with the laboratory conditions, demographic profile and anthropometric measurements of the population; this median sensory nerve inching study provides preliminary normative data that will aid in electrodiagnosis of carpal tunnel syndrome.

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